I claim:

SUB B1 >

1. A method for processing a material by locally raising the temperature of a material in order to facilitate chemical reactions or processes related to processing of the material, comprising the step of using an electrode to apply to the material a controlled succession of thermal spikes or shockwaves of varying energy through a growth medium, said thermal spikes or shockwaves of varying energy being generated by electrons emitted by or attracted to the electrode, wherein a dimension of said thermal spikes or shockwave, and an area of the material affected by the resulting energy transfer, is on the order of less than one nanometer to several tens of micrometers.

2. A method as claimed in claim 1, wherein said electrode is an electron emitter tip.

3. A method as claimed in claim 2, wherein said thermal spikes or shockwaves are generated by transmitting electrons from said electron emitter tip towards the material.

SUB B2 >

4. A method as claimed in claim 2, wherein said thermal spikes or shockwaves are generated by transmitting electrons from said electron emitter tip towards an anode in a direction generally parallel to a surface of the material.

5. A method as claimed in claim 1, wherein a duration of the thermal spikes or shockwaves ranges from a few picoseconds to several hundred nanoseconds.

sub B_3 >

6. A method as claimed in claim 1, wherein the growth medium is a cryogenic material in a gas, liquid, or supercritical state.

7. A method as claimed in claim 6, wherein the cryogenic material is a cryogenic liquid.

sub B_4 >

8. A method as claimed in claim 1, wherein said thermal spikes or shockwaves are generated by supplying to the electrode fast variable voltage pulses of on the order of a few picoseconds to hundreds of nanoseconds.

9. A method as claimed in claim 1, wherein said processing includes deposition of materials.

sub B_5 >

10. A method as claimed in claim 9, wherein said processing includes deposition of materials, followed by cleaning of the resulting product.

11. A method as claimed in claim 10, wherein said processing includes deposition of materials, followed by etching and cleaning of the resulting product.

12. A method as claimed in claim 1, wherein said processing includes etching.

sub B_6 >

13. A method as claimed in claim 12, wherein said etch gases used in said etching are selected from the group consisting of hydrogen, chlorine, and fluorine.

14. A method as claimed in claim 1, wherein said processing includes growth of material in a growth subcell, and etching and cleaning of the material in respective cleaning and etching subcells, said growth, cleaning, and etching subcells all being in communication and situated in a single growth cell to permit recycling of etched materials.

15. A method as claimed in claim 1, wherein said processing includes growth of material in a growth sub-area, and etching and cleaning of the material in respective cleaning and etching sub-areas, said growth, cleaning, and etching sub-areas all being in communication and situated in a single growth cell to permit recycling of etched materials.

end B6

16. A method as claimed in claim 1, further comprising the step of assisting said processing by applying photons from a photon source of sufficient energy to lower reaction barriers or to break or weaken chemical bonds.

17. Apparatus for processing a material by locally raising the temperature of the material in order to facilitate chemical reactions or processes related to processing of the material, comprising an electrode arranged to apply, in the presence of a growth medium, a controlled succession of thermal spikes or shockwaves of varying energy, said thermal spikes or shockwaves of varying energy being generated by electrons emitted by or attracted to the electrode, wherein a dimension of said thermal spikes or shockwave, and an area of the material

affected by the resulting energy transfer, is on the order of less than one nanometer to a few tens of micrometers.

18. Apparatus as claimed in claim 17, wherein said electrode is an electron emitter tip.

19. Apparatus as claimed in claim 18, wherein said electron emitter tip is arranged to transmit electrons directly from said electron emitter tip towards the material.

20. Apparatus as claimed in claim 18, wherein said electron emitter tip is arranged to transmit electrons from said electron emitter tip towards an anode in a direction generally parallel to a surface of the material.

21. Apparatus as claimed in claim 17, wherein a duration of the thermal spikes or shockwaves ranges from a few picoseconds to several hundred nanoseconds.

22. Apparatus as claimed in claim 17, wherein the growth medium is a cryogenic material in a gas, liquid, or supercritical state.

23. Apparatus as claimed in claim 22, wherein the cryogenic material is a cryogenic liquid.

24. Apparatus as claimed in claim 17, further comprising circuitry arranged to supply to the electrode fast variable voltage pulses of on the order of a few picoseconds to several hundred nanoseconds.

25. Apparatus as claimed in claim 17, further comprising a growth chamber;

a mechanism for introducing growth material and a growth medium into the growth chamber;

a mechanism for cleaning the growth medium to remove growth material and contaminants from the growth medium;

a controller for controlling said application of thermal spikes or shockwaves by said at least one electrode; and

a regulator for controlling temperature and pressure of cryogenic liquid placeable in the chamber.

26. Apparatus as claimed in claim 25, further comprising a mechanism for flowing the growth medium through or around the growth chamber.

27. Apparatus as claimed in claim 25, wherein the growth chamber includes a single growth cell divided into multiple subcells or sub-areas for sequentially processing a substrate or workpiece by deposition of materials, followed by etching or cleaning of a resulting product.

28. Apparatus as claimed in claim 27, wherein said multiple subcells or sub-areas are in communication, permitting recycling of etched materials.

29. Apparatus as claimed in claim 17, further comprising a photon source of sufficient energy to lower reaction barriers or to break or weaken chemical bonds in order to further assist said processing.

30. A product made by using an electrode to apply to a material a controlled succession of thermal spikes or shockwaves of varying energy through a growth medium, said thermal spikes or shockwaves of varying energy being generated by electrons emitted by or attracted to the electrode, wherein a dimension of said thermal spikes or shockwave, and an area of the material affected by the resulting energy transfer, is on the order of less than one nanometer to several tens of micrometers.

31. A product as claimed in claim 30, wherein said electrode is an electron emitter tip.

32. A product as claimed in claim 31, wherein said thermal spikes or shockwaves are generated by transmitting electrons from said electron emitter tip towards the material.

33. A product as claimed in claim 31, wherein said thermal spikes or shockwaves are generated by transmitting electrons from said electron emitter tip towards an anode in a direction generally parallel to a surface of the material.

34. A product as claimed in claim 30, wherein a duration of the thermal spikes or shockwaves ranges from a few picoseconds to several hundred nanoseconds.

35. A product as claimed in claim 30, wherein the growth medium is a cryogenic material in a gas, liquid, or supercritical state.

36. A product as claimed in claim 35, wherein said cryogenic material is a cryogenic liquid.

37. A product as claimed in claim 30, wherein said thermal spikes or shockwaves are generated by supplying to the electrode fast variable voltage pulses of on the order of a few picoseconds to hundreds of nanoseconds.

38. A product as claimed in claim 30, wherein said processing includes deposition of materials.

39. A product as claimed in claim 30, wherein said processing includes deposition of materials, followed by cleaning of a resulting product.

40. A product, as claimed in claim 30, wherein said processing includes etching of materials.

41. A product as claimed in claim 30, wherein said processing includes growth of material in a growth subcell, and etching and cleaning of the material in

respective cleaning and etching subcells, said growth, cleaning, and etching subcells all being in communication and situated in a single growth cell to permit recycling of etched materials.

42. A product as claimed in claim 30, wherein said product is a fine nanoscale structure.

43. A product as claimed in claim 42, wherein said product is further made by the step of using light to facilitate conductance of a top substrate layer of said product during a growth process.

P. 25
Fig. 12

44. A product as claimed in claim 43, wherein said fine nanoscale structure includes carbon and boron atoms deposited on a material which is conductive when illuminated.

45. A product as claimed in claim 42, wherein said fine nanoscale structure includes atoms selected from the group consisting of atoms selected from group IIB to VIIB of the periodic system as well as hydrogen.

P. 25
Fig. 12-14

46. A product as claimed in claim 42, wherein said fine nanoscale structure is a structure selected from the group consisting of a DNA probe device, a Nottingham cooling structure, and a CMOS device.